

Recent Advances in Water Engineering

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Recent advances in Civil Engineering are quite a few; however, it is equally true that much of the current research in Civil Engineering is exceedingly pedantic with very questionable practical utility. Too much attention is often focussed on issues that are of peripheral importance to the profession of Civil Engineering leaving pressing matters unattended. This is precisely what is impeding the development of the technology and the business of Civil Engineering at a pace similar to that which we see, for example, in Computer Science and Engineering .

That said, it is indubitably true that Civil Engineering has developed and advanced in quite a few areas. Let us zoom in on one such area, Water Engineering. Water Engineering includes Fluid Mechanics, Hydraulics, Hydrology, Water Resources Engineering, Wastewater Engineering, Groundwater Quantity and Quality-related Issues and Water Management. A huge amount of research has been done and thus a huge number of publications have been made in the field of Water Engineering recently.

Among the research problems that have been addressed in Water Engineering in recent times, the following are worth mentioning.

- Flow in meandering open channels.
- Flow in straight channels of compound cross-section.
- Flow in meandering channels of compound cross-section.
- Localised land subsidence due to groundwater depletion in the zone of influence of an individual well or a combination of wells for both linear (Darcian) and non-linear (Forcheimer) groundwater flow.
- Land subsidence due to groundwater depletion below cities.
- Groundwater flow modelling for non-linear (Forcheimer) flow.
- Modelling of saline water intrusion in coastal aquifers.
- Study of saline water intrusion in different geographies and mathematical modelling of the same.
- Developing an innovative method for fresh water extraction in coastal areas using a shallow level crossed-well cum vertical riser system with complete mathematical design of the same.
- Desalination of saline water.
- Study of arsenic contamination of water and its remediation.
- Disposal of arsenic sludge by fixing it in non-structural concrete.
- Groundwater movement in weakly and strongly randomly-heterogeneous flow fields.
- Earthquake hydro-geotechniques for both weak and strong earthquakes.
- Study of fluoride contamination of water and its remediation.
- Rainwater harvesting including rooftop rainwater harvesting.
- Development of software related to the water sector.
- Application of water-related software to solve complex water-related problems.

Continuing our focus on Water Engineering, making available drinking water, of adequate quantity and of acceptable quality, to the population is a major issue that must be addressed by the Civil Engineering profession. It is a fact that the piezometric level of groundwater is decreasing, sometimes at an alarming rate, under most, if not all, major cities. In large cities built on coastal alluvial soil, like Kolkata and Bangkok, this is causing soil consolidation and land subsidence which in turn is resulting, in some cases, to distress in superstructures. Sometimes, the quality of the water being supplied to the residents of a city is in the spotlight. Saline water intrusion plagues coastal areas and is a major problem in cities like Chennai. In certain other cases, presence of arsenic or fluoride or both in the

water source necessitate extensive treatment of the water before it can be supplied to the residents of a city.

Let us now take a look at two unsolved problems of current research. First, the issue of earthquake hydro-geotechniques for strong earthquakes has been addressed only qualitatively as a quantitative analysis still eludes the Civil Engineering profession. Second, no attempt has been made to determine exactly or even approximately the total soil consolidation due to the combined effect of groundwater depletion and superstructure loading. For the first problem, I have arrived at an approximate solution. For the second problem, I have proposed that, to begin with, a linear addition of the soil consolidation due to the two phenomena be done as a first approximation to the actual soil consolidation.

The Civil Engineering profession must aim at sustainable development. Sustainable development implies development in a manner that is well thought-out, that does not harm the environment, that can be sustained without the need to radically alter the development strategy due to insufficient thought-input during the process of formulating the development strategy and that is marked by wisdom in chalking out all steps of the development process. For cities, having green zones in a city, harvesting rainwater to augment water supply and using solar panels to generate electricity are all good practices that should be embedded in any city-planning plan.

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